

THE PROCEEDINGS *of* THE INSTITUTION OF PRODUCTION ENGINEERS

The Official Journal of the Institution of Production Engineers

Members are requested to correspond with the Editor upon matters of general interest. Letters may take the form of descriptions of unusual plant or tools, workshop methods, production problems or organisation systems. Only in exceptional circumstances will proprietary articles be dealt with editorially. Manufacturers wishing to draw the attention of the Institution to the merits of their products are invited to use the advertisement columns of this Journal. All correspondence should be addressed to the General Secretary, Institution of Production Engineers, 48, Rupert Street, London, W.1.

VOL. VIII.

SESSION 1928-29.

No. 3.

FIFTH ANNUAL DINNER.

THE fifth annual dinner was held at the Holborn Restaurant, London, on Saturday, November 10, 1928. Sir Alfred Herbert (President of the Institution) was in the Chair, and among those present were Mr. L. H. Hounsfield (President, Institution of Automobile Engineers), Mr. L. H. Pomeroy, Mr. A. J. Hancock, Mr. J. B. Hoblyn, Mr. R. H. Hutchinson, Mr. Gordon England, and a large number of members and visitors.

After the toast of "The King" had been honoured,

MR. L. H. HOUNSFIELD proposed "The Institution" and said he did so with pleasure and sincerity because the objects of the Institution were better and cheaper production in every class of industry, objects which were dear to the hearts of the members of the Institution of Automobile Engineers. Cheaper production would enable us to compete with the foreigner, to extend our businesses and employ more British labour and consequently more British capital. All this would also result in increased production per man, which, in turn, would have the effect of increasing not only output but the wages per man. One of the objects of the Institution of Production Engineers was to promote good relationships and he suggested that this might take a very practical form. When British manufacturers wanted new machine tools, and the British maker of such tools did not happen to be making the particular class of tool required, they were apt to be offered imported machine tools. Why could not the makers of machine tools in this

country put their heads together and produce the machine tools that were required, instead of having to import them and having to offer them to the users in this country because they were not made here. Of course, if every British machine tool maker were to make every type of machine that was required, it would not cheapen production, but, on the contrary, would put up prices. That was not the way to deal with this matter. It was a difficult matter for the big people who were competitors to put their heads together as to how certain types should be made, but was it not up to the Institution of Production Engineers to face the difficulty? This point reminded him of the automobile industry. Everybody was producing a 30-cwt. lorry, a 2-ton lorry, a 3-ton lorry, and a 4-ton lorry, and as far as the 1-ton lorry was concerned, until a short time ago this was left almost entirely to the foreigner. It seemed a pity that we could not concentrate on the production of one type of vehicle and produce it cheaply by a certain number of firms. Dr. Lanchester, at the last Olympia Exhibition, had said to him that the automobile men—both manufacturers and salesmen—were seized with a peculiar kind of blindness. They only saw the business they got and did not see the business they were losing.

Engineering divided itself roughly into two classes, construction and destruction. Civil engineering covered constructional engineering, and military engineering represented destructive engineering. Civil engineering covered every form of constructional engineering, and the Articles of Association of the Institution of Civil Engineers had been drawn so widely that they covered every form of constructional engineering that could be conceived. They therefore covered the objects of the Institution of Production Engineers and also the Institution of Automobile Engineers and from that point of view these Institutions would appear to have no *raison d'être*. The Institution of Civil Engineers obtained a Royal Charter 101 years ago and the members of the Institution of Civil Engineers could call themselves Chartered Engineers. Therefore, a Chartered Engineer might be a man who had spent the whole of his life in constructing canals, for example, but according to the Charter of the Institution of Civil Engineers he was more competent to deal with production engineers' problems than production engineers were themselves.

If production engineers looked for assistance in their problems from such bodies as the Institution of Civil Engineers the position was that they went to meetings and got a lot of information upon, say, mine ventilation, railway signalling, possibly on bridges and dams, but it was a long time before they got the specific information they required. By having Institutions which dealt with certain matters specifically, such as the Institution of Production Engineers, however, it was at once possible to get all the information that was available, and he suggested that Institutions of that kind should

have a Charter. (Hear, hear.) Where a Charter was granted, as in the case of the Institution of Civil Engineers, there was, unconsciously, a likelihood of deceiving the public. After all, the object of a Charter was to enable the public to see that a certain man was a Chartered Engineer or a Chartered Accountant, and therefore knew his job. It was possible, no doubt, 101 years ago for one man to have had a fairly good general knowledge of engineering as it existed at that time, but he certainly could not do so to-day because of the enormous ramifications of engineering, and it was to that extent that the title "Chartered Engineer" might be a little misleading.

An Institution is very much like a manufacturing business. In a manufacturing business the production department was invariably up against the designs department and the inspection department. The one wanted quantity and the other quality. The Secretary of an Institution could be compared with the production department. He wanted quantity; he wanted the Institution to grow in membership, although, of course, not regardless of quality. On the other hand the members of the Institution themselves wanted quality. It might be presumption on his part, but he had been looking through the rules of the Institution of Production Engineers and noticed that practically everything was left to the discretion of the Council. Certainly things should be left to the discretion of the Council, but Councils come and Councils go, whereas policy should go on for ever. Therefore, he suggested that the policy should be crystallised down to very carefully defined regulations as to what does and what does not qualify a man for membership. Those regulations, of course, would have to be modified from time to time, but it was very unsatisfactory to find that with changing Councils the quality of the membership might also change and that a change of policy might be decided upon at a badly attended Council meeting. One refreshing difference between an Institution and a manufacturing business was that it did not exist for the purpose of making profits and paying dividends!

MR. A. J. HANCOCK, who replied to the toast, expressed appreciation of the fact that a busy man like Mr. Hounsfield should have found time to come to the dinner and propose this toast. The Institution of Production Engineers had endeavoured to pay the Institution of Automobile Engineers a compliment by adapting its rules and regulations very largely from those of the Institution of Automobile Engineers, but at the same time he was not at all sure that the main object of the Institution of Production Engineers was, as Mr. Hounsfield had suggested, to obtain cheaper and cheaper production. Personally, he felt that a great deal of harm might be done if the chief aim and object was to reduce production costs. If we looked at the history of manufacture in this country it would be found that the mere reduction of manufacturing costs

had not been a source of profit or prosperity. The quality of the goods was as important as price. Mr. Hounsfield had mentioned the production of motor cars, which was almost inseparable from the work of the production engineer, and it had been inferred that it is in the reduction of production costs of the motor car that the production engineer would find his richest field. Again personally, he wondered whether that was so. The history of the trade of Great Britain did not suggest that it had triumphed in any particular direction because of low prices, and he felt it would be a dangerous thing if the Institution of Production Engineers were to feel that its whole object in life is to reduce manufacturing costs. Even in the motor car trade he believed it would be found that England will excel not by making something cheaper than any other nation—in that he did not believe England will succeed—but in making something different and better, something more ingenious and something more artistic—he was almost going to say, something more noble. The Morris car and the Rolls-Royce cars were examples of what could be done when we attempted not to copy other people but to provide something to meet our own special conditions. They were both cars which typified the qualities of this country in an admirable manner. Incidentally, a very great measure of justifiable profit had been enjoyed by the people who conceived these products. We only began to come “unstuck” when we attempted to copy other nations’ methods of production. It was not, therefore, sufficient for the Institution to say that because another nation could produce a particular product at a given price, therefore we could do the same. He suggested seriously that we could not because the conditions are so entirely different. and, therefore, as an Institution of Production Engineers their sole aim and object should not be the mere reduction of cost, but production in an economical manner of those particular qualities which were associated with this country and this country alone. The Institution of Production Engineers was a young organisation, but it had received the support of eminent engineering institutions and of eminent engineers. In particular, the Institution was grateful to Sir Alfred Herbert for having offered a prize for a particular type of paper. Mr. Hounsfield had referred to a Charter, but the Institution of Production Engineers was as yet far too young to aspire to that dignity; though the aspiration to a Charter was well within the Institution’s programme. He could say, at the same time, that the conduct of the affairs of the Institution would be such as to justify the grant of a Royal Charter and to justify its association with its fellow engineering institutions in this country, the keynote of which was usefulness, soundness, and dignity.

MR. L. H. POMEROY, proposing “Our Distinguished Guests,” specially referred to the presence of Mr. Hounsfield (President of the Institution of Automobile Engineers) and Mr. J. B. Hoblyn.

For Mr. Hounsfield he said he had the greatest admiration, because he had worked hard and sincerely for the Institution of Automobile Engineers for a great number of years. Nobody had done more encouraging work for that Institution than Mr. Hounsfield. Mr. Hoblyn he himself had rescued many years ago from the monotonous work of teaching chemistry to go to the Vauxhall Co. as metallurgist and general scientific expert. His first impression of Mr. Hoblyn was that he was a gentleman of distinctly Soviet tendencies, who seemed to think that commercial firms were here to-day and gone to-morrow, but he took him round the nine acres of the Vauxhall works—and they were there to-day. Mr. Hoblyn came to the Vauxhall Co. at a time when it really required some genuine scientific and metallurgical assistance, and at the end of six months he came to him and said he had made a great discovery; and that was that with the class of materials that had been put into the cars he wondered that they stood up for six months! That had given him the opportunity of replying to Mr. Hoblyn that the art of the engineer—and particularly the production engineer—was to make a mechanism out of muck!

To all the guests present he offered a hearty welcome. Mr. Hancock had spoken of the nature of production in this country and it was a point well taken. This country did not live on mass production alone and from his experience of mass production the less we had of it here the better. He had been interested in reading a paper that had been presented to the Institution a little time ago in which, as far as he could see, it was proposed that everything from the time the baby first put the bottle in its mouth to the time it was screwed down in its box at the end of its life, was to be the subject of motion study. This country, however, had always lived on individualism and he hoped it always would. The Englishman always put off trouble until to-morrow—and he, personally, could not think of a better place, unless it was the day after—and it was because of that habit of not anticipating trouble that we, as a nation, had accomplished what we had. After all, this country was a wealthy country. If we imagined what London was like twenty years ago we could see the change that had taken place. There were very few buses or cars, and if people in those days had been told that in twenty years time they would possess a motor car, they would have laughed. To-day, everybody had motor cars, and as one who was interested in making buses he claimed he was doing the ordinary motorist a good turn by providing vehicles which took the place of ten or a dozen ordinary vehicles. Incidentally, it was interesting to note that if we compared the prices of motor buses in this country with those in America it would be found that for generally the same specification the British-made buses cost 50 per cent. less than the American. Indeed, he was convinced that in this country we are just as expert in the high class production of

large quantities as any country in the world. There was one matter to which production engineers should give their minds. There existed in this country at the present time what was undoubtedly a most severe state of unemployment, probably the most severe in the world. Here we were, ten years after the war, with America going full bore, with Germany going full bore, and France doing very much the same thing, but out of all the great nations there was a greater burden on industry and more suffering to the workpeople in this country than in any other that he knew. What was the greatest anxiety a man could have on his shoulders? It was the fear that he might lose the possibility of being able to earn money. He had his responsibilities, his wife and his children, and the lot of the workpeople in this country was by no means as secure as it should be. Mr. Hounsfield had said that the work of the production engineer was to make cheaper things; really to make five men do the work where ten men did it before, and in that lay a very serious economic problem to which they should all address their minds. In conclusion, he had noticed a great tendency among production experts in this country to over-systematise and to try and use methods and tools which were not really suitable for the job. Many mechanical contrivances were used which were extremely ingenious, but in his opinion, simpler and more effective methods could be adopted.

MR. J. B. HOBLYN, replying to the toast and acknowledging the warmth of the reception that had been given to the Guests, said that production engineering is a new profession and is building up its tradition. It stood much in the same position as the younger universities and technical schools; there was nothing behind but everything before. Tradition was a noble thing and nothing could be finer than to work hard building up their own tradition and making people realise that they were alive and kicking, rather than to be the stick-end of some rocket, however brilliant, that had expended its energy thousands of years ago. The production engineer utilised the forces and the materials of nature and they were the bed rocks upon which production engineers must build. Whereas the forces and materials of nature might be the work of one man in his one laboratory, to make these forces and materials of benefit to mankind needed a whole army. In this connection he had been much impressed by the statement by the late Lord Justice Fletcher Molten in 1907 which was as follows:—"I have the deepest reverence for the masters of research, but when as it has happened to me many hundred times, I go to a manufactory and find there how under the stern rule of competition, economy has been introduced into every step, that no process is used unless it is either cyclic or leaves some waste product which can be utilised in some way. . . . when I see how these manufacturers have taken the difficult triumphs of the laboratory, and brought them

into practical life, so that those things that would have cost untold gold if they had been carried out in the original way, can be carried out economically so as to give the world cheaply the products of the process—when I see that, I feel just as much enthusiasm for the man who tackles the problem before him of making cheaply that which has been made by a *tour de force* in the laboratory, as I do for those who originally discovered it."

These, said Mr. Hoblyn, were noble words and he looked forward to the day when the production engineer would be looked up to as an essential unit in the life of the nation. If they made themselves known and rendered themselves indispensable to the industries associated with them, their success would be assured.

MR. R. H. HUTCHINSON, proposing the toast of "The President," said it was only three days ago that many of them had had the wonderful experience of going through the works that were conceived and controlled by Sir Alfred Herbert. Those works were a fine example of what production engineers should hold before them as their aim and object. They were laid out for production on the most modern and intelligent lines and must be accepted as an example of what such works should be. It was a pleasure to know that Sir Alfred Herbert had consented to occupy the Presidential Chair for a second year. As a past President, he himself could speak of the assistance Sir Alfred had given to the Institution. On behalf of the members of the Institution he extended to Sir Alfred their appreciation of his interest in the Institution.

He could never resist the temptation on these occasions to say something about the Institution. One point was as regards the aims and objects of the Institution. They must get a wider and bigger outlook altogether as to what their activities should be. As production engineers they were responsible for the manufacture of every engineering commodity whether it be sewing machines or ships, motor cars or mangles. It was not only a matter of machining. There were a number of aspects to which attention must be given which were just as important as machining. The production engineer was interested not only in the machining of the part, but in the work of the steel manufacturer and of the manufacturer of the raw material generally, the work of the designer and of the foundryman, because all these had a profound influence upon the work of the production engineer. His idea was that the Institution should not be regarded as one of production engineers who were merely producing in the factories machined parts; it should embody in its membership the designer, the steel manufacturer, the metallurgist, and the foundryman, and he foresaw the Institution linking up with all these branches of production engineering all over the country with a Governing Council controlling the various sections, with advisory committees in each branch. The Governing Council would give instructions for the papers that were to be read in the districts, the

debates would be recorded and sent to the Governing Council, who in turn would analyse them and send out further points for discussion throughout the whole of the country. Eventually it would be possible to collect such information that would bring the work of the various branches he had mentioned into close relationship and so definitely improve production engineering as a whole. Another important aspect of the work of the Institution of Production Engineers was to improve the training of the young engineer. Only in the previous week the chief of the technical school in Coventry had asked him to call a meeting of works managers in Coventry to discuss the training of the young engineer and elect an Advisory Committee to help the chief of the technical school in his work. Then there was the question of machine tool design. Production engineers more than anybody else could help machine tool manufacture. It was their bounden duty to point out to him where improvements could be made and to assist him in producing the types of machine that were wanted in order to prevent what the President of the Institution of Automobile Engineers had referred to, namely, the importation of machine tools because they could not readily be obtained here. The British machine tool maker was perfectly ready to produce everything that was required, but in the past, it was regrettable to state, the attitude had been that if the precise machine tool required was not available as a British make, they immediately went to an imported machine. Another phase of work was to bring the activities of the electrical engineer into closer relationship with those of production engineering because it should be possible to get the right type of electrical apparatus embodied in the machine tool itself. Then there was the safety of factories and the safety of operators of the machines, what was known as Safety First. The production engineer had ample opportunities to discuss and perhaps devise methods of protecting the operators from the accidents which happened to-day in enormous numbers. Again there was the vital question of unemployment which had been mentioned by Mr. Pomeroy in which the production engineer could play his part. All this indicated the size of field in which the activities of the production engineer had opportunities to function. To function usefully, however, the Institution must be strong, and must gather into its ranks all those people who had by their work and ability achieved a name in the profession. He claimed that they were entitled to go to such people and ask them to join the Institution, and it was for that reason that they were so grateful to Sir Alfred Herbert—one of those engineers who had reached a high position by his own ability and marvellous work—for giving the assistance he did. All this, of course, could not be done in a day, but if it took twenty years to achieve the object he had outlined they would have done well.

SIR ALFRED HERBERT, replying to the toast, expressed his pleasure

at the manner in which it had been proposed and received, and added that the speeches to which he had listened during the evening had been worthy of a technical session of the Institution. He was specially struck with the suggestions that had been made regarding the importance of the English Engineering Industry being developed in harmony with the English tradition. We, as a nation, had certain qualities and also the defects of these qualities. Along some lines of progress we had the ability to succeed, but in other directions we were apt to fall behind other countries, whose conditions and traditions were different from our own. Our object should be to develop those qualities of our national character which had helped to bring the nation into the position which it occupies in the world to-day. He claimed that our production engineers were an efficient body of men and that they ought to be given reasonable scope for their abilities and not to be put on black and white squares from which they were forbidden to move.

He was a great believer in freedom of development and if he were told by any constituted authority that there was only one line of machines which he was permitted to make at Coventry, that would be the only line in which he would never take interest at all, because he would immediately want to try his hand at something else. Sir Alfred paid tribute to his colleagues and staff and to his workpeople and expressed his gratitude for their loyalty and helpfulness.

In wishing the Institution every success he emphasized what Mr. Hutchinson had said as to the almost unlimited scope for the production engineer. He also stressed the importance of encouraging original thought; it was always more difficult to know what to do than how to do it. He believed that some of the suggestions that had been made in the various speeches to which he had listened as to the management of engineering concerns, would have equal importance in the minds of those present with the more technical questions to which the production engineer was supposed to confine himself. Let them always cultivate breadth of outlook and recognise that much as had been done in the past there still remained unlimited opportunities for enterprise in the future. He also asked his audience not to believe that people could get on in this world unless they had influence. In Sir Alfred's experience people seeking for jobs with personal recommendations and what is known as "influence" behind them usually required rather more careful scrutiny than those who came forward purely on their own merits and ability. Let everybody stand on their own feet and look forward to the future with confidence.

THE SCOPE AND WORK OF THE PRODUCTION ENGINEER.

Paper presented to the Institution, Coventry Section, November 19th, 1928. By C. R. F. Engelbach (Member).

THE work and scope of the Production Engineer is a somewhat difficult subject to approach, still more so to define the functional limits as to where his work begins and where it ends. These limits depend to a very large extent on the size of the factory in which he is employed and also on the personality and idiosyncracies of the management.

I take it, however, that for the purposes of this discussion that a Production Engineer's work in a large factory really engaged on production is indicated. By production I mean the manufacture of a large number of articles of a similar nature which are assembled into a product that is easily merchandiseable.

The work and scope of the Production Engineer, which I shall endeavour to define, therefore, are those of an engineer employed in such a factory, and, naturally—especially in Coventry—I shall use the automobile business as a good illustration of a production factory.

Here again the subject presents further difficulties as the work of a Production Engineer falls in large factories—by the term “large” I mean those which turn out at least 100 cars a week—into two categories; one perhaps which I may term the technical side and the other the commercial. The technical side consists in the Production Engineer receiving a drawing from the designs office; visualising the proper method of manufacture of the part or parts shown thereon, and knowing the capacity of the plant of the factory in question, making the layouts, ordering the jigs and tools, and arranging the machines so that the methods of effecting each operation shall be precisely outlined and used in a properly progressive manner.

In a factory such as I have used as a basis, say, 100 cars a week, there would be another engineer co-equal with the first, who takes on the work at that juncture and sees that the methods and machines with which he is provided by the technical side are used to their fullest capacity and the production proceeds in an orderly manner to the finishing end, ready for delivery to the Sales Department; in other words, the one provides the guns and ammunition for the other to fire.

The term Production Engineer therefore has a wide significance

in the factory. If there is only one man so termed he would require two assistants to carry out the separate duties outlined above.

In large factories where two such engineers are employed one may be termed the Production Engineer and the other the Production Manager, both of whom would probably come under a member of the Board who is termed the Works Director.

I shall now attempt more closely to define the duties of these two individuals in a properly organised factory.

I must acknowledge that the factory to which I belong is not properly organised, from the fact that the Production Engineer combines other duties, which, strictly speaking, are not part of his functions. In my firm the Production Engineer, who is called the Efficiency Engineer, is also the Works Engineer. The reason is due to the geographical difficulties in the Works and the constant general re-organisation of its plant that has been taking place during the last few years.

The Works Engineer's department should be, in my opinion, entirely distinct from that of the Production Engineer. He should have a different training and should possess knowledge of power, equipment and services ranging from the raising of steam to the production of power and electricity; also building and all such trades as bricklayers, carpenters, pipe fitters, plumbers, millwrights, etc. All these services should come under the Works Engineer who should be functionally separate from the Production Engineer. It is urged, due to the peculiar difficulties that exist in our own Works, that by combining the Works Engineer's department with that of the Production Engineer, the means of rearranging plant and the manufacture and erection of special appliances for facilitating work is more easily effected. We have the good fortune also to have a man who is peculiarly fitted by training and experience for this dual capacity, and such men are not easy to find, and as a general rule such a combination is to be deprecated.

Also, in my opinion, the Production Engineer should have the Jig and Tool Drawing Office and the Tool Room under his control. This is not so in our own factory, but here again the question of personality and training comes in and I am therefore discussing the matter on a purely theoretical basis.

I must assume that in every properly organised production factory all the preliminary work is done in the offices, or in other words, Superintendents or Foremen have to follow the rules for production as laid down by the Production Engineer's department. Although functionally the Production Engineer and Production Manager are of equal importance, the Production Manager must only use the tools provided for him and work in accordance with the methods laid down. Although the Production Engineer need not have any actual designing abilities so far as the particular part is con-

cerned that has to be manufactured, yet he has himself to design appliances and methods by which any articles have to be manufactured, and to be able to keep the Designs Department in check. He must also be able to indicate where alterations in designs are necessary for economical production.

We will assume that the Board of Directors have decided that a new design of car is to be manufactured and have given a sanction for 5,000 of these to be made at the rate of production of 100 per week.

The first problems that arise are dealt with by the Production Manager, who, having proposed the date when production should start, will give the Production Engineer a priority list showing the sequence in which the tools, methods and appliances of the various details should be available. After getting an approximate idea from the Production Engineer as to the dates by which the plant and tools will be ready, he can then instruct his Buyer—who should always function under the Production Manager—the date and rate of supplies that are required. The Production Manager should also order the patterns if he has his own Foundry and dies for the various stampings, if he is lucky enough to possess a Stamp Shop, etc.

The matter then, for the time being, passes out of his hands to that of the Production Engineer. Knowing the plant that he has at his disposal and the amount of capital expenditure the Board may allow both for new machines and tools, and knowing the rate of production that is required, it is his first business to arrange the various sections, and buy the necessary plant that will produce each individual piece most economically at the required speed. He therefore must possess an intimate knowledge of the latest machine tools and their capacity and capital cost. He must exercise his discretion and judgment in buying machine tools that will be best fitted for the purpose, having in mind the capacity of the machines already in the factory which will work in tune with those he proposes to buy. It is no use, for instance, his paying a very large sum of money for a highly productive machine if that machine is in line with other machines which will not work so quickly as the new purchase. If certain operations for example take an average of twenty minutes each, it is obviously no use buying a machine at a very high cost which will do one operation in say five minutes.

Having dealt with the machine tool question, the next procedure is to make layouts for the operations on each article, arrange the plant to be as far as possible in sequence of operations, and then send these layouts to the tool room to design and manufacture tools which will carry out the operations on these machine tools in approximately the times as shown on the layout. It is advisable before these layouts are completed and machine tools designed to ask the various shop superintendents for their opinion, but the

Production Engineer's ruling in all these matters must be final. It is then for the tool room to plan their work so that the tools are ready when the plant is fixed in position and the material from the Production Manager's side begins to arrive.

The Production Manager again now takes hold of the job and commences to feed the plant with the necessary materials. He has to plan the times of what might be termed the speed of flow, so that all the details arrive in proper sequence at the assembly line, and see that the production is maintained as far as is possible in accordance with the programme. It will be seen, therefore that both Production Engineer and the Production Manager must be engineers of big capacity, but the former deals with the mechanical side of production whilst the other the human side.

It is, of course, very difficult, and indeed impossible to lay down any exact divisions of responsibilities, and whoever is in charge of the work must regulate these responsibilities in accordance with the capabilities of his assistants. When you have a Production Engineer and Production Manager who thoroughly know and have confidence in each other's capabilities, each can devote himself entirely to his own side of the business with successful results. If this mutual confidence, however, is lacking, then trouble is bound to ensue. Production has a technique of its own and requires a different training experience from that of ordinary engineering. Our Universities and Technical Schools do not at present teach Production Engineering, but from the factory point of view, solely what is termed Works Engineering. As I have said previously, I think with all our Universities the time has come when a Chair of Production Engineering should be instituted, at any rate for the fourth-year students. I agree that to be of any use to a factory a common course of engineering should be taken to train the mind to think mechanically, but as students branch off from the third year to more specialised subjects, such as electrical, hydraualical, petroleum and other types of engineering and technology, it would be of great benefit to production factories, for those who wished to take the course, to spend a year under able instructors in the technique of production.

The Production Manager is born, not made, because no technical training can teach organisation and the proper way of dealing with foremen and workpeople. His is the business side of the show. He can sacrifice a good deal of technical knowledge to gain commercial instincts.

He must take an academical interest in machine tools and mechanical appliances, but this knowledge need not be intensive; in other words, a successful production manager must be a business man first and a technician afterwards.

Systems, charts, progress, planning—looking ahead and grasping

the main idea, namely, profit for the shareholder, should make up his Bible.

We have, then, two branches of Production Engineering which cannot be too closely defined as it is difficult to draw an exact dividing line between their responsibilities. The work and scope of a Production Engineer, therefore, begins with the receipt of drawings and ends with the despatch of the goods. His responsibilities are twofold, technical and commercial, and to be successful in either he must have qualities of heart, brain and commonsense in a high degree, and the greatest of these is commonsense.

An interesting discussion, opened by the President of the Coventry Section, Mr. R. H. Hutchinson, who occupied the chair, followed the presentation of Mr. Engelbach's paper.

A vote of thanks to the author concluded the proceedings.

WAGES DIFFERENTIA.

Some Collected Views of Members on Wages Problems.

Foreword.

IN the November number of *THE BULLETIN* of the Institution attention was drawn to an article by Mr. W. F. Watson, entitled: "Wages Differentia," that had appeared in the same month's number of *THE REALIST*. (November, 1929).

A summary of Mr. Watson's views was given, and members were invited to express their opinions on the subject. Their response has been so full and interesting that it has been found desirable to transfer the discussion from the pages of *THE BULLETIN* (our rather informal little publication circulated to members only) to those of *THE JOURNAL*.

As non-members of the Institution will not have had an opportunity of reading the summary of Mr. Watson's views, these are here reprinted from *THE BULLETIN*. The reprint will also serve to refresh the minds of members and enable them to read the contributions which follow with greater interest.

When members have completed their contributions to the subject, it is proposed to invite a prominent Jurist, a prominent Employer and a prominent Labour Leader to set out in these pages the conclusions to which a study of the contributions leads them.

Summary of Mr. Watson's Views.

The following summary of Mr. Watson's views, taken from *THE BULLETIN*, is here printed with the kind permission of the Editor of *THE REALIST*, in which the full article appeared, and of Mr. Watson:— In his "Notes on Contributors" the Editor of *THE REALIST* thus refers to Mr. Watson: "Started work as tradesman's errand-boy at ten. Left school at twelve. Entered engineering industry, at which he has worked ever since, at fifteen. Joined Amalgamated Society of Engineers in 1902. Still working as a mechanic. In thirty-two years at the trade has worked in fifty-two shops."

Mr. Watson opens by stating that one of the difficulties in the way of reconstruction and rationalisation in the engineering industry is the question of industrial remuneration. Though he quotes from an authority who asserts that the problem of getting an acceptable system of payment by results is one into which more brains will have to be put by employers and managers, he feels

justified from his own wide and varied experience in criticising various attempted solutions and in offering suggestions on his own part.

The American employers, he points out, were the first to realise that something would have to be done to give the workers an added incentive to adapt themselves to the new methods of large scale production. He states that the Differential Piece-rate Plan, first originated by F. W. Taylor, the founder of Scientific Management, does not appear to have met with any success in this country, but that in spite of the opposition of the workers, payment by results has come to stay.

He then goes on to examine various bonus systems, including the Halsey system, the Rowan plan, the Carlisle Agreement, the Priestman Co-operative Production Plan, and the Bedaux plan of "labour measurement."

Of the last-named system, Mr. Watson says that enquiries among those who operate it fail to bear out the high claims made for it. Workmen say that the rest allowances are inadequate, that they have to work very much harder, and that the values are so fixed as to make it impossible to increase earnings commensurate with the extra effort demanded.

Mr. Watson's experience is that the majority of engineering workers, including trade unionists, welcome payment by results. Where the wage is fixed regardless of output the time hangs heavily and one is apt to slacken. "But when complicated premium bonus systems are forced upon the workers; when nobody explains how the amount of their earnings is computed, in consequence of which the pay envelope is usually a bag of mystery; when time limits are secretly fixed by the management without in any way consulting the men or their representatives and when it is realised that rate cutting is rife throughout the industry, is it to be wondered at that the mind of the workman is filled with suspicion that he is not getting a square deal?"

Mr. Watson asserts that rate cutting still prevails. "Even where the principals of a firm disavow all knowledge or sanction of such practices, the rate fixer or foreman seems to think it his duty to reduce rates because, in his opinion, the operator is 'earning too much.'" It is this rate cutting which has done and is still doing so much mischief. "Indeed, the unions forbid their members, under pain of heavy penalties, to earn more than a given amount, usually time-and-a-third. I have had scores of jobs where I could easily have earned double my rate, but I idled my time away because I knew that if I doubled my earnings, the price would be cut, and the next man who got the job might not be able to earn his money."

"Such, then," writes Mr. Watson, "is the position in British engineering. Chaos and mismanagement everywhere; suspicion

and mistrust abound in the shops. Scores of different complicated systems are in operation in the multitudinous factories, details of which are not available to or understood by the men; piece rates are arbitrarily fixed by the employers; rate cutting is the rule, and there is no doubt that this deplorable condition of things militates against peace in industry, and against reconstruction and free development."

The suggestions Mr. Watson has to make for reform are as follows :—

There must be brought about that willing co-operation which the requirements of modern production demand—from the humblest workman to the managing director.

A uniform system of payment by results must be adopted which will be acceptable to the men. Mr. Watson advocates the plain piecework method, but suggests a plebiscite of the workers. Whatever system is adopted should be rigorously enforced on every firm, and all other systems ruthlessly scrapped.

As to rate fixing, which presents so many difficulties, no price should be fixed in any shop without consultation with the men or their representatives. In the big shops prices would be fixed through the works committees, and in the smaller shops through the "leading hand, i.e., the man to whom the others usually look for guidance."

As cases are bound to arise where, through some error of calculation in estimating, an equitable price cannot be mutually agreed upon by men and management, such cases might be referred to a kind of Arbitration Court, composed of, say, a trade union official and an independent employer. Rate-cutting and the limitation of earnings must be abolished as being obsolete.

Views of Members.

Mr. J. D. Scaife (Past President and Member of Council) :—

Probably there is no subject of greater importance than this to production engineers or to employers generally. The essential feature of a successful organisation is confidence on the part of the workers in the management. To establish and maintain this it is necessary that the workers should be satisfied that they are getting a fair return for any extra efforts put forward beyond the normal. It would be difficult, nowadays, to find an employer or manager who did not subscribe to this view and the question turns on the means which serve the purpose best.

Having been reared in the cotton manufacturing area of Lancashire where the direct piecework system has been the rule for generations, it is perhaps natural that I should lean towards that system, but my observation of others in operation has more fully established the supremacy of the direct piece rate. I have always

employed that system and 'never have I had reason to change. It has the advantage of being simple to understand and operate. One very important feature is that the direct piece rate requires considerably more care to fix. No sloppy estimation will suffice if the best use is to be obtained of modern production machinery.

Amongst ratefixers, I know, the advantage of the Rowan or similar system is that no very great care need be taken in fixing the rate, as the system itself takes care that the worker does not get away with too much wages no matter how the actual time compares with the set time. The net result with these systems is something in the nature of a present of easy money to the workers and something less than the best possible output from manufacturing plant.

Any system which lessens the wage rate per piece below what is considered a fair rate for normal production is bad and will lead to slackness in the organisation. Actually, any increase in production beyond what is considered normal production has a proportionally increased value to the organisation, though the disadvantage of complexity of operation makes a system based on this principle subject to suspicion and therefore unsound.

May I repeat that after thirty years of manufacturing my vote goes emphatically to the direct piece rate.

Mr. J. Bell (Member) :—

I am not at present on the production side of engineering and my remarks must not be taken as applying to the firm by which I am at present engaged. I lectured for some years at evening classes in London on this subject and was able to put into practice my ideas on it over a considerable number of years in works. I heartily agree with a great many of Mr. Watson's remarks and I consider that the real trouble in regard to the wages question arises very largely through the ill-advised action of engineering employers in using the piecework system in its early days as an excuse for price cutting. This is not merely an opinion, but the result of actual acquaintance with two very bad cases. The unions promptly retaliated by forbidding their men to earn more than a certain percentage over and above the actual day rate, and the Taylor and other systems of premium bonus or differential piece-rate schemes were devised as a means of overcoming the resistance of the unions to the system of payment by results.

Where the men were assured of a square deal I had never any difficulty in arranging for payment by results, and the only way in which a piece-rate, once set, could be altered was definitely agreed to be upon a basis of new methods devised and introduced by the management. I have always found the men perfectly ready to consider this arrangement.

Mr. Watson's statement in regard to the various premium bonus systems, that the pay envelope becomes a bag of mystery, is correct, in my experience. It is very difficult for the average workman to understand how the bonus is arrived at, even supposing that the details of the scheme are available for his inspection. On the other hand, although I consider with Mr. Watson that the piecework system is the best, there are other considerations which must be taken into account, particularly in big works where it is impossible to put every department on such a basis, and this has practically an individual application in each works on account of local conditions.

The question of fixing the rate for any new job has always been a vexed one. Some of the unions have made it a definite rule that no piece-rate shall be fixed except by discussion between the employer's representative(s) and a committee of the workers approved by the section concerned. Obviously, rates fixed under such conditions are likely to be of a more equitable nature, or at least of a more satisfactory nature than those fixed by the old and often commonly practiced arbitrary system where the men have no say in the matter at all except in a passive sense. Under these conditions, too, the need for an arbitration court does not arise, and I have not found it necessary to invoke the assistance of the employers' association.

To sum up, I would state that providing the management will assure its workers of a square deal and will arrange for appeal to a responsible official (if necessary to the managing director himself) in any case where suspicion arises, there will be no difficulty in arranging for any reasonable system of payment by results. Even in these enlightened days there are many employers who still fail to realise the value of the old adage that "honesty is the best policy." It is a reasonable consideration that owners and their managers have had the advantages of a better education than the workmen, therefore, proper consideration of the problem should be the first point in their programme.

The question of appeal to the heads of the firm is, I know, one that is very strongly objected to by many managers on account of the misuse that may be made of the right, but the matter can very well be arranged through proper channels which will, of course, include the shop committee acting for the men. This should be sufficient safeguard to prevent misuse of the right.

Mr. A. Perry-Keene (Member). Wages versus Earnings :—

"Your cost of production is too high." This is a sentence of commercial death to both Capital and Labour. Neither can escape the consequence no matter whether it is brought about by ca'canny or poor management. How shall we make sure that costs attain a proper ratio?

Too much attention has been paid in the past to prime cost and so-called "wages" and not enough to total cost including earnings (£5 earned can be much cheaper than a 50s. wage) together with oncost. Where the latter view is taken it at once becomes apparent that labour earning the higher amounts (always provided that the official layout of the work is correctly set up by the planning office) is the cheapest. Management knows that in the majority of cases total oncosts are likely to be at least as high as productive wages; therefore high and continuous production is the only logical way of watering down the effect of these charges. Under such circumstances any rate cutting by management which produces retaliation on the part of labour is expensive and detrimental to the prospects of both. Slow production taking away the possibility of "jobs" and handing them to more alert foreign producers. The economic history of England over the past one hundred years discloses some atrocious treatment of labour in the earlier decades. It has, however, been recognised for some time past that good remuneration in return for more output is only just and proper and the last two decades has seen a considerable rise in the standard of living. This can only be paid for by greater production per employee, therefore encouragement and not repression is the only logical method.

So-called rate setting and rate cutting can be dispensed with in a simple manner, which is carried out in practice by at least one large firm. Let the executive side of management show by actual physical demonstration that the particular work contemplated can be completed in the time shown on the layout. As the demonstrator can never be very expert (due to non-continuity) this is a fair method of setting time allowances, leaving the worker the chance of training and improving himself so as to produce larger quantities accompanied by greater earnings. Time saved is the solution of low production costs and opens the way directly to expanding markets. By whatever means it is obtained, be it better management or better agreement between parties, or less ca-canny, there is only one royal road to success, that is to save time, so lessening cost of production, so creating ample markets.

General Manager (Member, M.I.Mech.E.) :—

With regard to rate setting, I think we may take it that in general there is no policy. Rate fixing is often the best or the worst agreement that an ignorant foreman or untrained rate fixer can make with the workers.

Correct rate fixing can only be determined subsequent to motion and time study; and even then comes in manipulative skill which may involve training the operative. For example, you get a worker who can instinctively or by nature carry out certain work

100 per cent. faster and better than any others; you obviously cannot fix a rate upon this natural expertness.

I think the principle that Mr. H. E. Taylor outlines in his paper on "Production and Psychology," in the December number of THE JOURNAL as to a general increase in the earnings of workers following upon the introduction of a new machine, equipment or method is not altogether sound, since quite frequently the only advantage resulting from such a change is that the price can be reduced to meet a certain market level of prices, leaving no margin for an actual increase in the worker's rate. I think for the moment you cannot go further than to say that a firm is entitled to change the rate where there has been a change of element. Where there is a shop stewards' committee or even a works committee instead of a shop stewards' committee, it is possible to so work with such committee that it can form a court of appeal for the worker who is dissatisfied with a change of rate in order that, if his claim is in their eyes justified, they can put it up to the firm.

Personally, I consider that the major issue for capital, management and labour to tackle is the means by which the difference between direct wages and material charges on the one hand and selling prices on the other can be reduced. That is definitely the function of the management group.

Practice differs enormously, but it is a very usual thing to take the wages and materials cost and add 150 per cent. to that as the selling cost. In many cases it is a much higher figure; in a few cases it is lower. In one industry, for example, it is stated that direct labour charges are only 7 per cent of the selling cost of products. If that is the case—and I believe that in many directions it is something of that order—I ask, is it not sheer folly to fight at all about a difference of 5 per cent. up or down in wages when, as you see, it is only 5 per cent. on 7 per cent.? Surely, the thing to tackle is the difference between this 7 per cent. plus material costs, and the selling price.

Mr. G. H. Hales (Member of Council) :—

In the course of my career I have worked as apprentice, improver and journeyman under various systems of payment by results, including straight piecework and several of the premium bonus systems mentioned. As foreman, ratefixer, production engineer and works manager, I have been responsible for installing and administrating systems designed to provide for the worker an inducement for extra effort, and for the employer lower costs and additional profits.

I must at once admit that my experience makes me agree with many of Mr. Watson's statements.

I am sorry to say that I have had recent evidence which supports

the statement that price or rate cutting still exists. In my opinion this is directly due to the inefficiency of people responsible for fixing the basis times for operations. In giving this opinion let me make it clear that I am not attacking that much-maligned officer, the ratefixer, but calling attention to the vital importance of accurate rate-fixing in the engineering industry, and to the necessity for providing the ratefixer with conditions whereby he can attain efficiency.

Payment by results is sound and just both to worker and employer, and, provided an efficiently organised administration can be assured, it is generally acceptable to both. Many valuable Papers have been published on the subject. The authors of these have generally had a wide experience in large organisations whose size, capital, and product justify the employment of specialists in their planning, rate-fixing and related departments. Unfortunately there are hundreds of engineering firms in this country whose product does not call for sufficient quantity of repetition operations to justify the employment of specialists. We may reasonably assume that the more favourable relations between employer and employee in America are due to a great extent to the large scale of manufacture, which lends itself so well to research, invention, technical development and scientific production methods.

There are many branches of engineering in this country (in which we may perhaps include the manufacture of marine engines, locomotives, printing machinery, etc.) where there exists a mutual desire for payment by results. In many such factories some form of bonus system is attempted. The whole work in connection with this (which may include estimating, lay-out of operation sequence, rate-fixing, etc.) may be carried out by one officer termed the Production Engineer, with the help of one, two or three assistants, according to the work involved; alternatively one rate-fixer, or even just the shop foreman. Accurate rate-fixing under these circumstances is extremely difficult. The person responsible for it must have not only an expert knowledge of machine shop operations (which may include turning, milling, grinding and gear-cutting), but in addition his memory regarding available stocks of material, floating tools and equipment used on previous operations of a similar nature, etc., must be prodigious, since the new product may be in small quantity batches that do not warrant special tooling.

In many cases these officials may be highly efficient in carrying out their duties as a whole, but often they are in no way equipped with the training necessary for a rate-fixer whose decisions are so vital to the good relationship essential between worker and employer.

The various bonus systems referred to by Mr. Watson in his article, of which the Rowan System is a glaring example, were

designed to safeguard the employer (and perhaps the rate-fixer) from the consequence of allowing the worker a ridiculously high price or time for performing an operation. It is obvious that in the case of a workman receiving under a bonus system an outrageously high remuneration, an error in rate-fixing must have occurred, and when the attention of the management is called to this error, the person responsible for setting the rate is put "on the carpet." We can readily imagine that the fear of the consequence of his error may cause a rate-fixer to resort to rate-cutting. I have knowledge of such a case where the management could truthfully disavow all knowledge of the practice. Take an illustration: Assume that the ordinary hourly wage of a worker performing a certain operation was 1s. 6d., and that the quantity of work represented thirty hours. By increased effort or outstanding skill, assume that it be possible for certain workers to perform the operation in twenty hours, or by exceptional skill or effort in eighteen hours minimum. I have known cases where the rate allowed by the person responsible for setting it might vary from fifteen hours to sixty hours. That is a wide margin of error, but it is not exaggerated, and I feel sure that many members of our Institution can recall similar discrepancies or errors of judgment in rate-fixing.

The degree of accuracy in rate-setting in many factories must depend upon the amount of experience the rate-fixer has had on work of a similar nature. It must be understood that in many engineering firms it is impracticable for an operation to be tried out before the price or rate is fixed, owing to the small quantities called for and the variety of parts. The practice in many such firms is for the officer termed rate-fixer to receive from the designer blue prints of the component parts as quickly as these can be detailed, so that he can get ahead with laying out the sequence of operations and set the piecework price or bonus rate, at the same time advising in conjunction with the jig and tool department *re* any slight modification in the design to facilitate production. Where pattern making is called for, this work, together with the necessary ordering of materials, is being carried out almost simultaneously; or, if stock materials are available, the work is passed out to the shops as soon as dealt with by the rate-fixer.

I hope I have illustrated some of the difficulties under which this important question of payment by results labours in this country. While it may be considered that the responsibility for putting the present unsatisfactory conditions in order rests mainly with the employers as a body, much assistance might be given by our Institution, through ventilating the importance of the matter and through setting out a specially graded course of training embracing motion study, analysis, etc., in close co-operation with the educational authorities, particularly the technical associations.

I purposely refrain from advocating any particular system of payment by results, though I think several different systems might be successfully organised to suit different sizes, grades, and conditions of engineering production. The subject is too big to attempt to expound my views here, but if my remarks arouse interest and discussion among members of the Institution I shall have attained my object.

Mr. J. Ronald (Member) :—

I have read the article in *THE REALIST* by Mr. W. F. Watson.

Having travelled along much the same path as the writer—mainly on the administration side of the fence—I am in a position to judge as to the justness of his strictures on certain types of wages systems, and I am bound to admit that with a great deal of what he says I am in agreement.

Generally speaking wages systems can be grouped under the following heads :—

- (1) Daywork.
- (2) Profit-sharing schemes.
- (3) Bonus, Premium Gift-sharing Schemes and Propositions.
- (4) Piecework—Straight and Differential.

(1) Daywork.—What is the matter with daywork? After all, a very large proportion of the wage-earners of the world are paid an hourly, daily, or weekly wage. A great number of them are doing work not capable of being paid by the piece, such as clerical and administrative work. Excluding these, and assuming that some standard of equivalent value is expected and given for services, we have left those dayworkers whose work can be, if sufficient pains are taken, resolved into equivalent time and money values. It is said that there is no incentive to this class of dayworker, that daily wages, and the same wages for each, offer nothing at all to induce one man to do more than another, or to do more than just hold his job. But do we not rather deceive ourselves with platitudes? The incentive to the worker should be his wage plus his pride in doing what he ought to be well paid for. The value given is the employer's responsibility, and he should specify it. He can only do so by employing an efficient organisation, specially trained for the purpose of determining an equivalent unit of work for a given unit of wage.

(2) Profiting-sharing Schemes.—In my opinion schemes of this description should only be applicable to workers whose work cannot be definitely evaluated, principally clerical, administrative, and fugitive labour. Where such schemes are engrafted on some other system, such as piecework, bonus systems or daywork, as an inducement for added effort, they fail because of the lack of specific quantity control. They provide no machinery for specifying the amount of work individually produced in a given period.

(3) Bonus, Premium Gift-sharing Schemes and Propositions.—Let me say at once that I am opposed to all forms of bonus or premium systems. I believe them to be fundamentally unsound and illogical. All of them have been designed, no doubt with the best intentions, to ensure to the worker the highest possible wage, and to the employer, the lowest possible cost per piece. One at least, the Rowan Premium System, goes, if possible, a stage further and definitely insures the employer against his own folly—bad rate-fixing. It was a common practice years ago (and I am not sure that it is not still prevalent) for employers to appoint semi-skilled, non-skilled and non-technical men as rate-setters. Whatever the idea (and I suspect it was economy) the results were and are on the whole appalling.

In the year 1902, after I had installed the Rowan Premium System in the works of a large firm of general engineers in Glasgow, I was given the job of installing it in the works of a number of subsidiary firms throughout the country. All of these firms were working a piecework system, and I had the opportunity of examining their piecework prices. Many were grotesque, few were reasonable. Some were too low, many too high. Piecework in each of these works was an economic failure, not because of any inherent defect in the system as a system of wage-earning, but because of its faulty administration. In no single case was there a skilled engineer employed in setting rates. Either a clerical individual (called a piecework clerk) or a shop foreman was entrusted with what appears to me to be one of the most important functions of shop management. In each of these cases a stage had been reached where a bonus system of some kind was an economic necessity (at that period no modification or alteration in piecework prices would be tolerated by the unions), and the Rowan System offered the best solution.

Let me repeat that all Bonus Premium and Gift-sharing Systems are unsound. I believe them to be so because :

First.—They do not ensure to the worker a constant price per piece.

Second.—They do not ensure to the employer a constant cost per piece.

Third.—They do not give the worker all he earns.

Fourth.—They compel the employer to fix a fictitious time value or rate.

Would one, as a business man, suggest to his baker that he supplied him with bread on the Halsey Bonus System, or to his fishmonger, that he supplied fish on the Rowan Premium System ? There should be no necessity to buy labour on any such artificial system, and to my way of thinking the only justification for their introduction (about thirty years ago) was the endeavour, economically forced upon employers of labour, to find some means of recti-

ying the mistakes made in administering straight piecework systems.

(4) Piecework.—Piecework, although one of the oldest systems of wage-earning, appears to me to be the only system where pay is exactly proportioned to the amount of work done. This system, then, is a just system to the worker, but, I submit, fundamentally unjust to the employer, because it embodies no safeguard against bad rate-setting. This is a somewhat startling statement to make, but I hope to justify it.

Before dealing with that aspect of the matter there is one classical objection to the system, an objection held by many wage earners, which must be mentioned. It is held that immediately a worker begins to earn a higher rate of wages than his employer thinks reasonable, his price is reduced. Well, it may be, and many times it is so, but is there a bonus or premium system which can be by any stretch of imagination be held to be free from the same disability? I know of none.

It may be submitted that a pledge is given on the introduction of these systems that rates will only be reduced if some improvement in the method of manufacture is adopted. True, but the same pledge might equally well be given by employers running a piecework system, and, if I may say so, might equally as easily be broken. Who amongst us is there, having intimate knowledge of the operation of either Bonus Premium or Piecework Systems who can say that on occasions he has not known prices and times so cleverly manipulated that justice was outraged? In a paper on Rate-fixing read by me before the Institution two years ago I said: "We find all kinds and combinations of wages systems covering in their effect, and often their intention, all kinds of rate-fixing, bad, indifferent, good. Is it too much to say that if we could ensure accurate rate-fixing all of these artificial wages systems might be abolished? But what would replace them? An hourly rate with an equivalent unit of work accurately determined by the ratefixer." Piecework, as we know it, pays proportionally to the work done. As I have stated, this is just to the worker.

But it does not always pay proportionally to the time occupied in doing it, and in this respect it is unjust to the employer. Wherever plant and facilities are provided by an employer, the time factor influences the cost irrespective of the wages system in use. Hence, if a price is given which tempts a worker to produce less than his best the employer suffers economically, his charges being higher, proportionally, per piece than they ought to be. Hence the justification—and I use this word advisedly—of a reduction in price.

Personally, I see no ethical reason why an employer should suffer two wrongs even although one of them (i.e., bad rate-fixing) is his own fault. Surely the sinner may at least have the satisfaction of repenting? I think I have shown that Bonus Premium Systems

are, in the main, clever and ingenious methods of attempting to overcome the results of incompetency in rate-setting.

The question may now be asked : "How do you purpose remedying this state of affairs and what is this system of piecework with a time equivalent?"

As to the remedy, in the Paper previously mentioned, I said : "I will enumerate the qualities required to make an efficient rate-fixer :

- "(1) He must have a practical knowledge of the trade for which he intends fixing rates.
- "(2) He must possess the faculty of analysis.
- "(3) He must be temperamentally precise and careful.
- "(4) He should possess a sound technical education, particularly in the mathematical and mechanical subjects pertaining to his trade.
- "(5) A knowledge of psychology is indispensable."

Such a man is the key to the remedy. Before correct rates can be set, exact knowledge must replace guesswork, and exact knowledge can only be obtained and used efficiently by trained and educated men. Employers should only employ this type of man in their rate-setting departments, and because of the dearth of them, should encourage their training.

I hold that the matter of accurate rate-fixing is of vital importance to the engineering industry of this country and, that such being the case, a real and practical interest should be taken in this by our Engineering Institutes, particularly our own Institution, as well as by the employer, Engineering Employers' Federation, and the Engineering Trade Unions, who are likewise vitally affected.

I think this interest should take the form of a properly graded course in motion study, analysis, etc., open only to students qualified as practical mechanics with technical knowledge. This course of study should be mutually agreed upon by the above organisations and the necessary pressure brought to bear upon the educational authorities to adopt it in technical schools in engineering centres. Apart from a few large firms in the country who are alive to the importance of the subject, and who, to some extent, train their own men, nothing seems to have been done in the matter.

Lest it be thought that I have stressed the importance of the necessity of accurate rate-setting too much, may I make a personal explanation? I was trained in one of the largest mass-production factories in this country where the wages system was straight piecework. I have administered the Rowan Premium System, Differential Piecework, the Halsey Bonus System, and one or two variants of these. I have personal knowledge of about a dozen strikes (all sectional or local), where the cause was a dispute regarding piecework or bonus rates. I have had under my control during the past twenty-five years many rate-fixers, but I do not remember

one who had not to be personally trained, or trained by my staff, before he became efficient. It has been said so often that it is largely believed that you only want to take your best turner from the lathe, or your best smith from the anvil, and you have your ideal rate-fixer. Believe me, it is not true. Having given the above personal explanation, I ask members to believe that I am not attacking rate-fixers as a body. I am attacking the conditions which offer them no opportunity of becoming efficient and advocating means whereby they can become so. I expect criticism and am prepared to answer it. A discussion in our journal will open a safety valve which has been closed too long.

As to the wages system I favour. Let me repeat—an hourly rate with an equivalent unit of work accurately determined or a price per piece per unit of time. They mean the same, provided the hourly rate is the same for the same piece, which should be the basis of the scheme. The price should be fixed to allow the hypothetical average man to complete the quantity required in the time given without undue fatigue.

No restrictions would be placed on the operator doing more if he could, but with the type of rate-fixing and rate-fixer advocated, real fatigue would prevent the worker from overstepping the quantity specified. I do not know a piecework system as above-outlined in existence anywhere, but I think it would be as easily operated as a straight piecework system, the time factor operating as a safeguard to the employer and enabling him to employ, on any given job, only those workers who were efficient. There I leave the description of this system in the hope that correspondence and criticism may be forthcoming.

Mr. W. G. Grocock (President, Birmingham Section) :—

The extract from the article, "Wages Differentia," which appeared on page 6 of Bulletin No. 3 was interesting from three different points of view. It was interesting in the first place because the question of payment of workers is one of the most important that production men have to consider.

It was interesting also because the author made many statements which I personally think he could not substantiate.

The third point of interest was that it was another of those cases where "fools rush in where angels fear to tread."

Taking the last two items first, it is clear that if the author had been into 52 shops in 32 years, he had never stopped anywhere long enough to appreciate whether the system of pay was a good one or not. He had been there probably just long enough to absorb the froth which appears on the surface obviously first, and this froth, so far as payment by results is concerned, always hinges around the statement that rates are cut. They can never, however,

bring forward actual cases for discussion where such rates have been cut without also changing operations.

I myself remember the time when rates used to be regularly cut and it was understood, but as a workman, foreman, and manager, I know of no single instance where the management have given their word that they will not cut rates, and have not lived up to their word. All sound managements give that undertaking to-day, but they qualify it naturally, by saying that if they change operations, or improve the method of producing the work, then they retain the right to re-time the work itself.

There is no subject which will yield better returns for any thought put into it than that of the earnings of our workpeople. Payment by results is the only logical method of pay, but there are so many methods of achieving this that usually discussions hinge about these methods. To deal with all of them would require a lengthy book, but I would like to deal briefly with three systems which are in common use.

The Rowan System.

In this system the basis is a fixed time allowance for the work itself, and the savings on this time made by the workman are divided in a certain way as between the employer and the employee. Under this system it is impossible for a workman to earn double time, and the system itself is fundamentally wrong inasmuch that the savings that accrue to the workman are more per piece when he is doing a poor job, or having a relatively small output, than they are in the case when he has a relatively large output.

It will be conceded, I think, by everyone who has thought this matter over, that the reverse condition should exist, namely, that the higher the output of the individual, the larger the amount should be that should accrue to the workman himself.

The Halsey System.

Under the Halsey system there is a set time for the job, and the savings made on this time are divided equally between the employer and the employee.

While this system is better than the Rowan, it still suffers from the same complaint, namely, that it does not reward the employee for the extra efforts that have to be put in to accomplish the maximum savings.

My own preference in payment by results is for a straight piece-work price. Both the Rowan and the Halsey systems are based on a fundamental misconception, namely, that we cannot rate-fix a job accurately. We can, but it may be an expensive proposition in those cases where only a few pieces of work have to be done. When the work is repetition in character, then it pays very definitely to have your Time Study and Rate Fixing Department get right

down to a minimum time ; make the necessary additions to give the time and a third which is usually allowed for the average individual, and then transform time into money and pay a fixed sum per piece.

For myself, I have a distinct preference for paying a bonus in addition to this for those who are highly efficient. In other words, when an employee can definitely earn above, say, time and three-quarters, then for every piece that he can do beyond this stage, I believe in giving a bonus to such individuals.

It will be seen that such a system works distinctly in the opposite direction to either the Rowan or the Halsey system. In these two systems the actual wages cost per piece to the workman goes down as his efforts increase. Under the suggested system the wages cost per piece to the employee goes up when he reaches that point where very great efforts, or skill, are needed to produce the extra pieces. This appears to me to be the best way to achieve maximum output from our employees.

The Bedeaux System.

The Bedeaux plan, "Labour Measurement," was mentioned, and while in America I had an opportunity to discuss this with certain executives who were using the system, and from these discussions I formed the conclusion that such a system would be a very useful one to put in provided it was operated in the way I suggest for straight piecework, namely, that an efficiency point was fixed and when the employees reached this point then an extra bonus was paid.

The Bedeaux system depends on very close time study, and quite clearly when such time study has taken place, particularly in machine work, then very little opportunity exists for operators to do more work than the time study would suggest. The idea of having a committee of the workpeople themselves to handle the question of rate fixing, or even to give them a voice in such, is, in my estimation, too fantastic to need consideration. I know that certain firms are flirting with this idea, but the inefficiency that exists in such firms will, of course, in time, give the death blow to any such silly scheme.

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